11

TERRESTRIAL ECOLOGY

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SUPPLEMENTARY REPORT TO THE EIS

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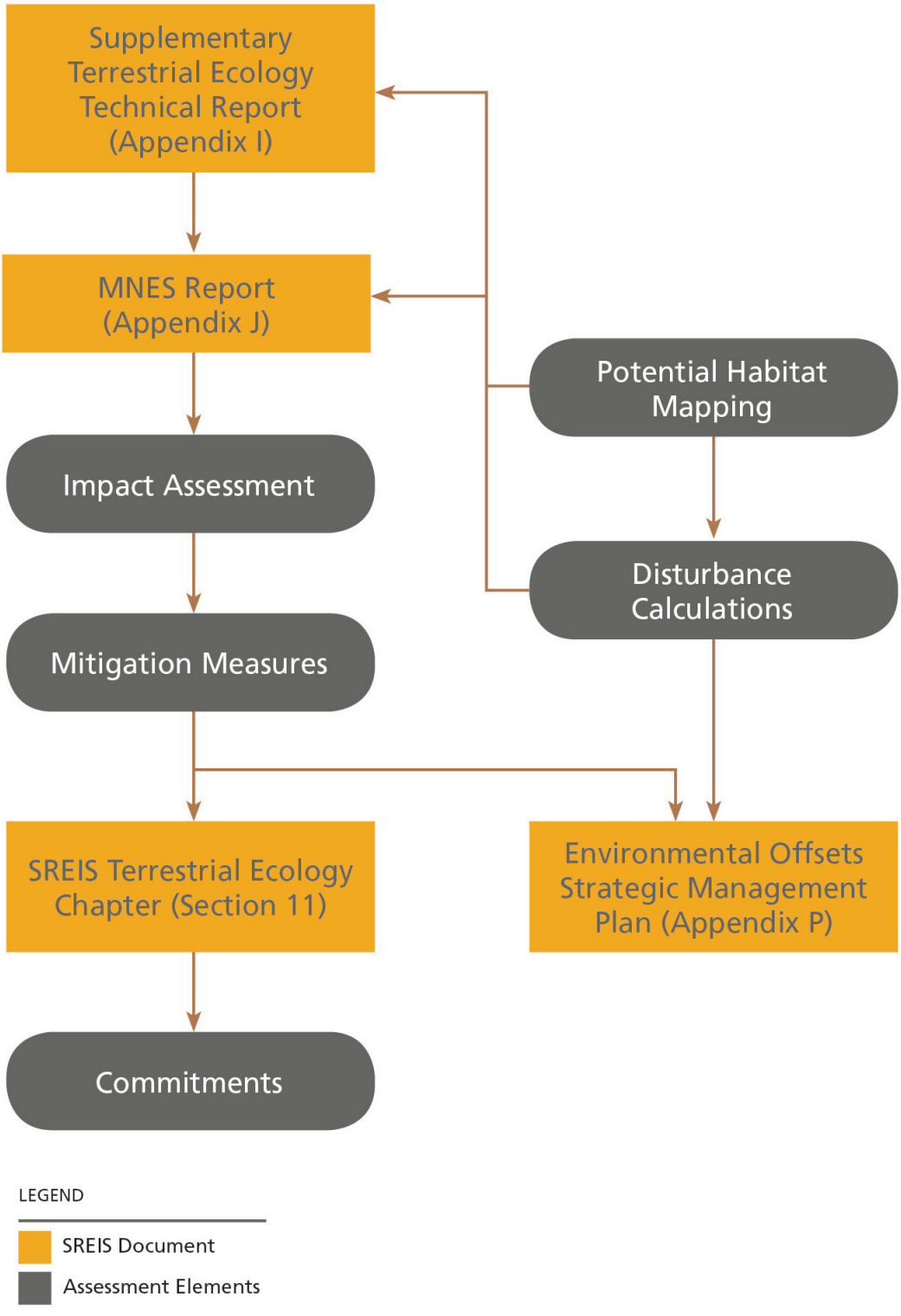
11 Terrestrial Ecology

11.1 Study Purpose

The supplementary terrestrial ecology assessment was undertaken to determine any revised potential impacts on terrestrial ecological values from Project activities arising from changes to the project description, and updates to relevant State or Commonwealth legislation subsequent to the Project EIS. Additionally, this report provides extended discussion around particular submissions made following the public consultation stage of the Project EIS.

The ecological studies for the supplementary report to the EIS (SREIS) includes a number of supplementary and updated assessments. The relationship between the various elements of the updated supplementary assessments is illustrated below in Figure 11-1. The assessments include:

- **Supplementary Terrestrial Ecology Assessment (Appendix I) of the SREIS:** The Supplementary Terrestrial Ecology Technical Report of the SREIS is a standalone report that outlines the methodology and results of the supplementary assessment undertaken to meet the objective outlined above.
- **MNES Report (Appendix J) of the SREIS:** The Matters of National Environmental Significance (MNES) report of the SREIS is a standalone document to provide an update to, and supersede the previous MNES report provided in the EIS.
- **Terrestrial Ecology Chapter (Section 11) of the SREIS:** The Terrestrial Ecology chapter of the SREIS is a summary to the terrestrial ecology studies undertaken for the SREIS, and is to be read in conjunction with the Terrestrial Ecology chapter of the EIS.
- **Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS:** The Environmental Offsets Strategic Management Plan is a standalone report outlining the offsets strategy for the Project in line with relevant State and Commonwealth legislation and policy.



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BOWEN GAS PROJECT SREIS

ECOLOGY ASSESSMENT SUMMARY

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TERRESTRIAL ECOLOGY

Figure: **11-1**

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11.2 Studies and Assessments Completed for the EIS

This section provides an overview of the terrestrial ecology impact assessment completed for the EIS and the main conclusions from that assessment.

The assessment identified and described terrestrial ecology values within the Project development area through desktop research and field surveys in selected areas.

The desktop study included a review of relevant literature, database searches, and examination of aerial photography to inform the selection of sites to target during the field surveys. Sites for field surveys were selected to sample a range of ecosystems and validate their presence, and to identify sensitive vegetation communities and in particular potential core habitat for flora and fauna species. Flora surveys were undertaken at 632 floristic survey sites across the Project development area comprising 102 secondary, 20 tertiary and 510 quaternary sites. In addition, 47 tertiary survey sites and 81 quaternary sites were recorded within the Project development area in studies undertaken by URS in 2011. Fauna studies were conducted at 334 sites comprising 260 sites subject to active fauna searches, 39 sites featuring formalised trapping techniques and 35 sites where fauna observations were undertaken in recent associated studies (3d Environmental and Ecosmart Ecology, 2012).

Data from the desktop review and field based survey for both flora and fauna was analysed and a list of threatened species, ecological communities and Regional Ecosystems (REs) considered relevant or potentially relevant to the Project was compiled. A likelihood of occurrence assessment was undertaken based on available records, known species and habitat distribution, and habitat suitability.

Three nationally significant threatened ecological communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were identified within the Project development area during the field surveys with an additional community considered as a ‘possible’ occurrence. A total of 78 REs (excluding RE sub-types) are mapped within the Project development area including representation of 18 endangered REs (biodiversity status) with 20 listed as 'of concern'. Two threshold REs (being those in danger of falling below 30 % of their pre-clearing extent) are also recognised. No 'critically limited' REs are known to occur in the Project development area. The field surveys refined the mapping extent of REs detected.

Sixty-three flora species listed as either endangered, vulnerable or near threatened (EVNT) under federal and state legislation were identified during EIS desktop searches as being potentially present within the Project development area. This included 17 species of national significance under the EPBC Act and 49 species of state significance under the *Nature Conservation Act 1992* (NC Act). Of these, 51 species were excluded from the assessment due to the absence of recent records and suitable habitat within the Project development area. Consequently, 12 species listed as either endangered, vulnerable or near threatened under federal and state legislation may potentially occur within the Project development area. Eleven NC Act listed species and four EPBC Act listed flora species are known from the Project development area.

Potential impacts from project activities (construction, operation and decommissioning) identified by the terrestrial ecology impact assessment include:

- Habitat fragmentation and isolation of populations;
- Habitat loss or degradation and fauna mortality;

- Pest species invasion; and
- Edge effects.

The protection of terrestrial ecological values will be primarily achieved through design and site selection that results in avoidance of high-value environmental areas.

Commitments relating to minimising impacts to terrestrial ecology values were developed based on professional advice from 3d Environmental and EcoSmart Ecology. The EIS found that Project design and site selection for specific infrastructure that seeks to avoid these high-value sites is the primary means by which protection for terrestrial ecology values will be achieved. Table 11-8 lists the commitments presented in the EIS to avoid (where required) and reduce the significance of impacts to terrestrial ecology values in the Project development area.

11.3 Changes to Project Description Relevant to Terrestrial Ecology

As reported in the EIS, up to 6,625 production wells were to be drilled throughout the Project area over the approximate 40 year Project life. The current planning for a conceptual development footprint is for approximately 4,000 production wells to be drilled throughout the Project area over life of the Project. This entails a reduction in the order of 2,625 wells from the original estimate.

In addition to reducing the number of wells, by positioning multiple wells on one well pad, the number of well pads has been reduced. The updated Project Description chapter (Section 3) of the SREIS introduces the use of multi-well pads with up to 12 wells being constructed on a single pad.

The pad sizes and number of wells per pad has been standardised to facilitate construction. These standardised well configuration footprints are presented in Table 11-1 below. The table presents the footprint of each well pad configuration during the drilling and construction phase, after which, the size of the well pad is reduced for operations. More detail on the well pad configurations is provided in Project Description chapter (Section 3) of the SREIS.

Table 11-1 SREIS Multi-Well Pad Disturbance Footprint

Well Pad	Disturbance Footprint
4 wells (2 vertical production + 2 lateral)	130 m x 175 m (22,750 m^2)
8 wells (4 production + 4 lateral)	130 m x 235 m (30,550 m^2)
12 wells (6 production + 6 lateral)	130 m x 295 m (38,350 m^2)

This reduction in well numbers and well pads translates to a decrease in the amount of land disturbed for wells and construction of associated linear infrastructure such as trunk lines, gathering lines and access tracks. As the multi-well pads consolidate a group of wells at one surface location, targeting multiple coal seams, they will typically result in:

- A reduction in the total number of well pad sites;
- A reduction in the individual pad area required per well;

- A significant reduction in the number of gathering lines, resulting in a significantly reduced construction and disturbance footprint; and
- Increase the average distance between any two well sites.

The Project design changes since the EIS to the conceptual development footprint have resulted in a decrease to the project disturbance footprint as outlined below in Table 11-2.

Table 11-2 EIS vs SREIS Estimate Maximum Disturbance Areas of the Conceptual Footprint

Infrastructure	EIS		SREIS	
	Number	Disturbance	Number	Disturbance
Wells (production + lateral)	6,625	16,098 ha	Approximately 4,000	5,977 ha
Linear Infrastructure	7,287.5 km*	18,219 ha	3,494 km	8,734 ha
FCF	10	85 ha	33	251 ha
CGPF	5	75 ha	2	25 ha
IPF	3	320	NA	NA
WTF	NA	NA	2	120 ha

* based on an estimated average length of gathering line and associated infrastructure per well.

Due to the nature of CSG development, the specific construction footprint for the life of the Project is still to be determined. A sample conceptual footprint has been designed for the Project which has been used to also estimate the potential disturbance limit for the life of the Project. The disturbance limits calculated are a conservative maximum disturbance estimate and it is highly anticipated that the likely actual disturbance during the Project will be lower than those impacts estimated. In addition to this built in conservatism to the maximum disturbance calculations, disturbance impacts are likely to be further reduced by the mitigation commitments for site scouting and avoidance of impacts where possible at the planning and pre-construction stages.

11.4 Changes to the Regulatory Framework

The Terrestrial Ecology Technical Report (Appendix P) of the EIS detailed the State and Commonwealth legislation, policy and guidelines relevant to the Project. These were reviewed as part of the SREIS to determine if any changes had been made subsequently that could affect approvals or environmental permitting for the Project.

11.4.1 Queensland Government

The following Queensland Legislation was reviewed as part of the EIS:

- *Environmental Protection Act 1994*;
- NC Act;
- *Vegetation Management Act 1999* (VM Act);
- *Land Protection (Pest and Stock Route Management) Act 2002*; and

- *Draft Code of Environmental Compliance for Level 2 Petroleum Activities.*

No changes to these Acts or guidelines relevant to the Project were identified.

A number of species of wildlife were reclassified by the Scientific Technical Committee on 26 July 2012. Table 11-3 details the species and changes to classification made.

Table 11-3 Changes to NC Act listed Wildlife Status since Publication of the EIS

Species	Common Name	NC Act status in EIS	Updated NC Act status in SREIS	Likelihood of occurrence in EIS
Dichanthium setosum	bluegrass	Near threatened	Least concern	Known
Acacia gittinsii	-	Near threatened	Least concern	Unlikely
Choricarpia subargentea	scrub ironwood	Near threatened	Least concern	Unlikely

Of the three species, only *Dichanthium setosum* is known to occur within the project development area. As it is also listed under the EPBC Act, it is considered a species of conservation significance and will be managed according to the principles outlined in the EIS.

11.4.2 Commonwealth Government

Commonwealth legislation reviewed as part of the EIS was restricted to the EPBC Act. No changes to this Act relevant to the Project were identified as relevant to the terrestrial ecology aspects.

In May 2013 the Commonwealth Government changed the threatened listing to a number of EPBC Act-listed fauna and flora species. These are detailed in Table 11-4

Table 11-4 Changes to EPBC Act listed Wildlife Status since Publication of the EIS

Species	Common Name	EPBC status in EIS	Updated EPBC status in SREIS	Likelihood of occurrence in EIS
Acacia ramiflora	-	Vulnerable	Not listed	Unlikely
Croton magneticus	-	Vulnerable	Not listed	Possible
Digitaria porrecta	finger panic grass	Endangered	Not listed	Known
Leucopogon cuspidatus	-	Vulnerable	Not listed	Unlikely
Delma labialis	stripe-tailed delma	Vulnerable	Not listed	Known
Paradelma orientalis	brigalow scaly-foot	Vulnerable	Not listed	Known
Rostratula australis	ustralian painted snipe	Vulnerable	Endangered	Unlikely

As shown in Table 11-4 *Delma labialis, Paradelma orientalis* and *Digitaria porrecta* are the only species known to occur within the Project development area that have been delisted. However, as

they are both listed under the NC Act, they are considered as species of conservation significance and will be managed according to the principles outlined in the EIS.

It should also be noted that holly-leaved graptophyllum (*Graptophyllum illicifolium*) was represented in the EIS as lacking a status under the EPBC Act. Holly-leaved graptophyllum is actually listed as 'Vulnerable' under the EPBC Act. As this species is unlikely to occur in the Project area (Section 11.5.1), this correction has no bearing on relevant matters (such as offsets) in the SREIS.

11.4.3 Non-statutory Mechanisms

The following non-statutory mechanisms were reviewed as part of the EIS:

- Biodiversity Assessment and Mapping Methodology;
- *Nature Conservation (Protected Plants) Conservation Plan 2000*; and
- Weeds of National Significance.

No changes to these non-statutory mechanisms relevant to the Project were identified.

11.5 Updates to EIS Findings

11.5.1 Review of the Likelihood of Occurrence Assessment for Flora

Desktop analysis undertaken during the EIS identified 63 flora species listed under State and Commonwealth legislation that may occur within the Project area. This included 17 species of National significance (EPBC Act) and 49 species of State significance (NC Act).

Further analysis of literature and EIS field surveys indicated that 51 species are unlikely to occur in the Project area due to low precision records or lack of suitable habitat.

Public submissions and a third-party technical review recommended that a re-appraisal of the likelihood of occurrence assessments be undertaken for two listed flora species.

11.5.1.1 Holly-leaved graptophyllum (EPBC: V; NC: V)

It was highlighted in the public submissions that a flora species, holly-leaved graptophyllum (*Graptophyllum illicifolium*), is known to occur in the Project area.

Research into this species shows that is endemic to central coastal Queensland from the Mackay area with a disjunct population at Miriam Vale, The EPBC Act Species Profiles and Threats (SPRAT) database notes that it grows in tall to very tall mixed notophyll forest. This is a coastal rainforest community and does not exist within the project area. Current records of the species obtained from the Queensland Herbarium (2 April 2014) confirm that all specimens are located in coastal and subcoastal rainforest and vine thicket communities. No records are within or are in close proximity to the Project Development area with the closest record over 50 km away to the north-east of ATP749.

The Terrestrial Ecology Technical Report (Appendix P, Table 11) of the EIS notes the presence of *Graptophyllum illicifolium* as Unlikely. As tall to very tall mixed notophyll forest is not present in the Project development area, the likelihood of occurrence for this species has been retained as Unlikely.

11.5.1.2 Omphalea celata (EPBC: V; NC: V)

Submissions identified that the occurrence assessment for *Omphalea celata* be reviewed against new information. The Terrestrial Ecology Technical Report (Appendix P)of the EIS noted the likelihood of occurrence for *Omphalea celata* as Unlikely.

Omphalea celata is known from three sites in central east Queensland. Locations include Hazlewood Gorge, near Eungella; Gloucester Island, near Bowen; and Cooper Creek in the Homevale Station area, north-west of Nebo (TSSC, 2008).

At Hazlewood Gorge, *Omphalea celata* grows in fragmented semi-evergreen vine thicket along a watercourse on weathered metamorphics in a steep-sided gorge at an altitude of 560 m (Forster, 1995). At Cooper Creek, plants grow in the creek bed and adjacent bank (TSSC, 2008h). Prime potential habitat is present approximately 10 km east of the Project development area in the Hazelwood Gorge area which features rocky riparian open forests supporting vine thicket communities.

Additional to the above, the distribution of *Omphalea celata* is not known to overlap with any EPBC TEC community. *Omphalea celata* was not detected during flora field surveys undertaken as part of the EIS, however the closest records are located outside the north eastern margin of the Project area (300 m) within suitable habitat in Homevale National Park.

It is considered that potential exists for this species to occur further along Cooper Creek within the Project area. However this part of the creek is confined to Homevale National Park which is designated as a “no go” area in the Project’s constraint’s mapping (Appendix CC of the EIS) and will be excluded from potential Impacts.

Despite the proximity of this record, the preferred habitat for the species is extremely uncommon across the Project development area, and is only likely to be found along Cooper Creek within Homevale National Pak. As such, the remainder of the Project area (outside Homevale National Park) is unlikely to support this species. *Omphalea celata* is considered to have an overall low likely of occurrence within the Project area, with the exception of Cooper Creek where there is a moderate likely hood of occurrence. Given that this species has a low likelihood of occurrence within the Project area (excluding the restricted Homevale National Park area where it’s a moderate occurrence along Cooper Creek) no further impact assessment or habitat mapping has been undertaken for this species.

11.5.2 Review of the Likelihood of Occurrence Assessment for Fauna

The Terrestrial Ecology Technical Report (Appendix P, Table 15) of the EIS notes that a total of 33 EVNT fauna species under the NC Act and/or the EPBC Act have been recorded from the study area. This includes one amphibian, four reptiles, 19 birds and eight mammals. The relevance of EVNT species to the Project development area was evaluated based on the number of records, record date,

species habits (e.g. highly mobile / nomadic), their habitat requirements and Known ranges, to produce a list of Known, Possible or Unlikely species.

Public submissions and a third-party technical review recommended that a re-appraisal of the likelihood of occurrence assessments for a number of listed fauna species be undertaken.

11.5.2.1 Red goshawk (EPBC: V; NC: E)

A third-party technical review of the Terrestrial Ecology Technical Report (Appendix P) of the EIS recommended an amendment to the likelihood of occurrence assessment for the red goshawk (*Erythrotriorchis radiatus*). The Terrestrial Ecology Technical Report for the EIS (Appendix P) noted the likelihood of occurrence for the red goshawk as Unlikely. This was based on habitat for this species within the Project development being marginal and that very few known records in the region suggesting it is not a regular inhabitant of the area.

A review of habitat, distribution and historical data suggests suitable nesting and feeding habitat (including forest and woodland with a mosaic of vegetation types, large prey populations (birds), and permanent water) is minimal within the Project area. However, the proximity of the Project tenements to large tracts of vegetation in conjunction with the consideration of historical distribution has led to a precautionary upgrade of occurrence to Possible (Table 11-3).

It should be noted that within the MNES Report (Appendix J) of the SREIS the likelihood of occurrence assessment for EPBC-listed species uses five criteria: Very Low, Low, Moderate, High and Recorded. The red goshawk has been accorded a rating of Moderate in the MNES Report.

As a result of the upgraded likelihood of occurrence of Possible for the red goshawk, potentially habitat mapping and a species profile is included the MNES Report (Appendix J) of the SREIS and potentially impacted habitat is considered as part of the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS.

11.5.2.2 Yakka skink (EPBC: V; NC: V)

A third-party technical review of the Terrestrial Ecology Technical Report (Appendix P) of the EIS recommended an amendment to the likelihood of occurrence assessment for the yakka skink (*Egernia rugosa*). The Terrestrial Ecology Technical Report (Appendix P, Table 15) of the EIS noted the likelihood of occurrence for the yakka skink as Unlikely. This was based on a lack of known nearby records which suggested the species does not inhabit the area.

Further research on the yakka skink shows that it does not occur within or in close proximity to the Project area. However, two records occur in proximity to the southern gas field. As it is considered that marginal habitat (including open dry sclerophyll forest, woodland and scrub) may exist in Project tenements, the likelihood of occurrence for the yakka skink has been amended to Possible (Table 11-3).

It should be noted that within the MNES Report (Appendix J) of the SREIS the likelihood of occurrence assessment for EPBC-listed species uses five criteria: Very Low, Low, Moderate, High and Recorded. The yakka skink has been accorded a rating of Moderate in the MNES Report.

As a result of the upgraded likelihood of occurrence of Possible for the yakka skink, potentially habitat mapping and a species profile is included the MNES Report (Appendix J) of the SREIS and potentially impacted habitat is considered as part of the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS.

11.5.2.3 Black-chinned honeyeater (NC: NT)

Public submissions identified that the occurrence assessment for the black-chinned honeyeater (*Melithreptus gularis*) be reviewed against new information.

The black-chinned honeyeater was included in the Terrestrial Ecology Technical Report (Appendix P, Table 15) of the EIS, with a likelihood of occurrence of Possible. In contrast, Table 18 of the same report states it is Known to Occur within the Project development area.

Given that records for the black-chinned honeyeater exist in the Project development area, the likelihood of occurrence table for fauna has been upgraded to reflect the known presence of black-chinned honeyeater (Table 11-5).

There will be no material change to the impact assessment or mitigation measures for this species as a species profile and impact assessment was undertaken within the Terrestrial Ecology Technical Report (Appendix P) of the EIS on the basis that the black-chinned honeyeater was included on a Possible likelihood of occurrence.

11.5.2.4 Glossy-black cockatoo (NC: V)

A third-party technical review of the Terrestrial Ecology Technical Report (Appendix P) of the EIS recommended an amendment to the likelihood of occurrence assessment for the glossy-black cockatoo (*Calyptorhynchus lathami*). The Terrestrial Ecology Technical Report (Appendix P, Table 15) for the EIS noted the likelihood of occurrence for the glossy-black cockatoo as Unlikely. This was based on the lack of records away from Blackdown Tableland National Park which suggested that occurrence outside this area was very irregular.

Whilst the Atlas of Living Australia provides only two records of glossy-black cockatoo within the Project tenements (dating from 1845), a number of recent records from Blackdown Tablelands National Park bordering the southern tenements exist. Given that belah (*Casuarina cristata*) and other species of *Casuarina and Allocasuarina*, noted food trees, are found throughout the Project tenements, the likelihood of occurrence for the glossy-black cockatoo has been amended to Possible (Table 11-5).

As a result of the upgraded likelihood of occurrence of Possible for the glossy-black cockatoo, potentially impacted habitat will be included as part of the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS.

11.5.2.5 Grey goshawk (NC: NT)

A third-party technical review of the Terrestrial Ecology Technical Report (Appendix P) of the EIS recommended an amendment to the likelihood of occurrence assessment for the grey goshawk (*Accipiter novaehollandiae*). The Terrestrial Ecology Technical Report (Appendix P, Table 15) for the

EIS noted the likelihood of occurrence for the grey goshawk as Unlikely based upon the presence of marginal (sub-optimal) habitat and lack of records.

No records for the grey goshawk are present within the Project tenements (Atlas of Living Australia, 2013). However, two records are found in proximity to the tenements (both approximately 10 km away) and a cluster of records is present near Eungella approximately 20 km to the north-east of ATP749. Based on these records, and the suitability of habitat within the Project tenements (especially in the north-east and south-east), the likelihood of occurrence for the grey goshawk has been amended to Possible (Table 11-5).

As a result of the upgraded likelihood of occurrence of Possible for the grey goshawk, potentially impacted habitat will be included as part of the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS.

11.5.2.6 Square-tailed kite (NC: NT)

A third-party technical review of the Terrestrial Ecology Technical Report (Appendix P) of the EIS recommended an amendment to the likelihood of occurrence assessment for the square-tailed kite (*Lophoictinia isura*). The Terrestrial Ecology Technical Report (Appendix P, Table 15) of the EIS noted the likelihood of occurrence for the square-tailed kite as unlikely as although dispersing individuals may be found sporadically within the Project development area; individuals are unlikely to inhabit the area. Further research has indicated that the square-tailed kite may utilise suitable habitat within the Project area and as such its likelihood of occurrence has been amended to Possible (Table 11-5).

As a result of the upgraded likelihood of occurrence of Possible for the square-tailed kite, potentially impacted habitat will be included as part of the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS.

Table 11-5 Summary of EVNT Fauna Likelihood of Occurrence in Project Development Areas Based on Database Searches

Status	Known	Possible	Unlikely
EPBC			
Presumed Extinct			*Psephotus pulcherrimus* paradise parrot
Endangered		*Dasyurus hallucatus* northern quoll	*Anthochaera phrygia* regent honeyeater *Poephila cincta* black-throated finch *Lathamus discolor* swift parrot *Bettongia tropica* northern bettong

Status	Known	Possible	Unlikely
Vulnerable	*Denisonia maculata* ornamental snake *Paradelma orientalis* brigalow scaly-foot *Delma labialis* stripe-tailed delma *Geophaps scripta scripta* squatter pigeon *Phascolarctos cinereus* koala	*Nyctophilus corbeni* south-eastern long-eared bat *Egernia rugosa* yakka skink *Erythrotriorchis radiatus* red goshawk	*Pedionomus torquatus* plains wanderer *Rostratula australis*** Australian painted snipe *Turnix melanogaster* black-breasted button-quail *Dasyurus geoffroii* western quoll *Onychogalea fraenata* bridled nailtail wallaby
NC Act			
Presumed Extinct / Extinct			*Psephotus pulcherrimus* paradise parrot *Dasyurus geoffroii geoffroii* western quoll
Endangered		*Erythrotriorchis radiatus* red goshawk	*Anthochaera phrygia* regent honeyeater *Poephila cincta* black-throated finch *Lathamus discolor* swift parrot
Vulnerable	*Denisonia maculata* ornamental snake *Paradelma orientalis* brigalow scaly-foot *Delma labialis* stripe-tailed delma *Geophaps scripta scripta* squatter pigeon	*Jalmenus eubulus* pale imperial hairsteak *Nyctophilus corbeni* south-eastern long-eared bat *Calyptorhynchus lathami* glossy black-cockatoo *Egernia rugosa* yakka skink	*Pedionomus torquatus* plains wanderer *Turnix melanogaster* black-breasted button-quail *Rostratula australis* Australian painted snipe *Ninox strenua* powerful owl

Status	Known	Possible	Unlikely
Near Threatened	*Acanthophis antarcticus* common death adder *Nettapus coromandelianus* cotton pygmy-goose *Ephippiorhynchus asiaticus* black-necked stork *Chalinolobus picatus* little pied bat *Melithreptus gularis* black-chinned honeyeater	*Accipiter novaehollandiae* grey goshawk *Lophoictinia isura* square-tailed kite	*Cyclorana verrucosa* rough collared frog *Lerista allanae* greater robust fine-lined slider *Strophurus taenicauda* golden-tailed gecko *Neophema pulchella* turquoise parrot *Tadorna radjah* radjah shelduck *Aerodramus terrareginae* Australian swiftlet *Turnix melanogaster* black-breasted button-quail *Bettongia tropica* northern bettong *Kerivoula papuensis* golden-tipped bat

As a result of the change of likelihood of occurrence for the reviewed species, the summary of EPBC Act and NC Act species Known, Possible or Unlikely to occur within the Project development area has been amended:

EPBC Act -

- Five Known (five vulnerable);
- Four Possible (one endangered, three vulnerable); and
- Ten Unlikely (four endangered, five vulnerable, and one presumed extinct).

NC Act -

- Nine Known (four vulnerable, five near threatened);
- Seven Possible (one endangered, four vulnerable, two near threatened); and
- Eighteen Unlikely (three endangered, four vulnerable, 9 near threatened and two presumed extinct / extinct).

11.6 Changes to Potential Impacts from Key Project Components

Since publication of the EIS, Arrow's field development plan and conceptual design for the Project has advanced. As a result of changes to the conceptual design, the potential impacts from key Project components have been amended. As the placement of Project infrastructure will be decided in part by the site's ecological values, any amendments to the field development plan will not necessarily equate to impacts on vegetation communities, habitat or EVNT species.

11.6.1 Central Gas Processing Facilities

EIS Project development planning featured integrated processing facilities (IPFs) in addition to the central gas processing facilities (CGPFs). The total area for each IPF was estimated at 120 ha. The CGPFs (without water treatment facilities (WTFs)) at the EIS stage were 15 ha in size.

The current Project development has CGPFs (with WTF) replacing IPFs (term no longer used), with each CGPF requiring up to 72.5 ha (including 60 ha for a WTF). This equates to a decrease in potential disturbance of 62.5 ha.

11.6.2 Field Compression Facilities

Due to the low wellhead pressures in the Bowen basin, FCFs will be installed to boost the gas pressure to enable the transportation of the gas over longer distances. FCFs will also include a water transfer station to facilitate transfer of water from FCF to FCF en route to a CGPF.

EIS planning estimated that each FCF was to be an area 200 m by 250 m or 5 ha. Current Project planning proposes the largest FCFs to have a total area of 200 m by 380 m or 7.6 ha, which equates to an increase of 2.6 ha for each FCF facility.

11.6.3 Wells

11.6.3.1 Well Numbers

As reported in the EIS, up to 6,625 production wells were to be drilled throughout the Project area over the approximate 40 year Project life. The current planning for a conceptual development footprint is for approximately 4,000 production wells to be drilled throughout the Project area over the life of the Project. This entails a reduction in the order of 2,625 wells from the original estimate.

11.6.3.2 Pad Sizes and Overall Disturbance Area

EIS Conceptual Design

On a nominal 800 m grid pattern, an indicative density of one producer well per 65 ha to 130 ha was typically expected. During the drilling phase, each well pad was to occupy an area of 8,100 m^2 (90 m by 90 m) such that for each SIS dual-lateral producer, the required collective well pad area (for the three separate pads) was to be approximately 24,300 m^2.

Once the well is installed, the footprint was to be reduced to approximately 10 m by 10 m such that for each SIS dual-lateral producer, the required collective well pad operational area (for the three separate pads) would be approximately 17 m by 17 m.

As noted in Section 11.6.3.1, above, approximately 6,625 production wells were expected to be drilled throughout the Project area. At 24,300 m^2 each, this would equate to an approximate maximum disturbance area of 16,098 ha. Following installation this area would be reduced with the surrounding disturbed area rehabilitated.

SREIS Conceptual Design

During the drilling phase, the estimated area for multi-well pads will be 130 m by 175 m (for a 4 well pad), 130 m by 235 m (for an 8 well pad) and 130 m by 295 m (for a 12 well pad).

For the whole of the Project area the distribution of each well pad configuration is anticipated to be as follows:

- 4 wells pad = approximately 71% of the development;
- 8 wells pad = approximately 21.5%; and
- 12 wells pad = approximately 7.5%.

Based on the assumption that approximately 4,000 production wells will be drilled throughout the Project area:

- 4 wells pads will disturb approximately 6,461 ha;
- 8 wells pads will disturb approximately 2,627 ha; and
- 12 wells pads will disturb approximately 1,150 ha.

The total approximate disturbance to land from well development, using the SREIS multi-well pad approach, is 10,238 ha. This is an approximate reduction of 5,860 ha from the estimate in the EIS development plan. These estimates do not necessarily equate to disturbance to ecological values, which will only occur where clearing is undertaken in previously uncleared areas. An estimate of the potential maximum impact to the ecological values is presented in the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS and summarised in Section 11.7.

As detailed in Table 11-6 below, the area required for drilling is only temporary. Once drilling is completed, the site will be rehabilitated to a smaller area required for the operational footprint. This estimated operational footprint includes erosion and sediment control buffers and may be reduced further between return rig visits for well intervention / well maintenance, dependent on individual well access requirements.

Table 11-6 SREIS Well Configurations

Well Pad	Drilling Footprint	Operational Footprint
4 wells (2 vertical production conduit + 2 lateral wells)	130 m x 175 m (22,750 m^2)	100 m x 155 m (15,500 m^2)
8 wells (4 vertical + 4 lateral)	130 m x 235 m (30,550 m^2)	100 m x 215 m (21,500 m^2)
12 wells (6 vertical + 6 lateral)	130 m x 295 m (38,350 m^2)	100 m x 275 m (27,500 m^2)

11.6.4 Gathering Systems

The change from single-well lease pads to multi-well lease pads has allowed a significant reduction in the disturbance caused by the Project. By reducing the number of well pads, not only has the total area for required well pads been reduced, the number and length of gathering lines has also been significantly reduced.

11.6.5 Refinement of Field Development Planning

Field development planning has advanced since preparation of the EIS, with the overall Project development area now being separated into 33 smaller drainage areas. Each drainage area is generally a 6 km radius catchment area for gathering well production (gas and water) to surface production facilities located at or near the centre of the circle. Each of these centrally located surface production facilities is a field compression facility (FCF).

The application of the drainage area approach has allowed for a refined analysis of RE mapping (from EHP) potentially affected by the Project. The focus of development will occur within the drainage area, although some impacts will occur beyond the drainage area boundaries. Within each drainage area, a discrete set of REs can be ascertained and potential impacts can be determined in isolation or in combination with other drainage areas. Impacts will also be calculated for areas outside of the drainage areas where Project infrastructure is proposed.

Thirty-three drainage areas are located across the Project tenements. These have been scheduled for development across three distinct phases. These are depicted in Figure 11-2.

An analysis of the EHP RE data has been conducted for each drainage area. Due to the nature of CSG development, the entire construction footprint for the life of the Project is still unknown and will develop in line with the framework approach. A conservative conceptual layout has been designed the project to calculate the maximum potential disturbance for the life of the project. The disturbance limits calculated are the maximum disturbance footprint and the actual disturbance during the Project will be lower than those areas shown below.

The method used for determining the entire project disturbance is as follows:

1. Disturbance of each environmental value for the sample conceptual footprint was calculated.

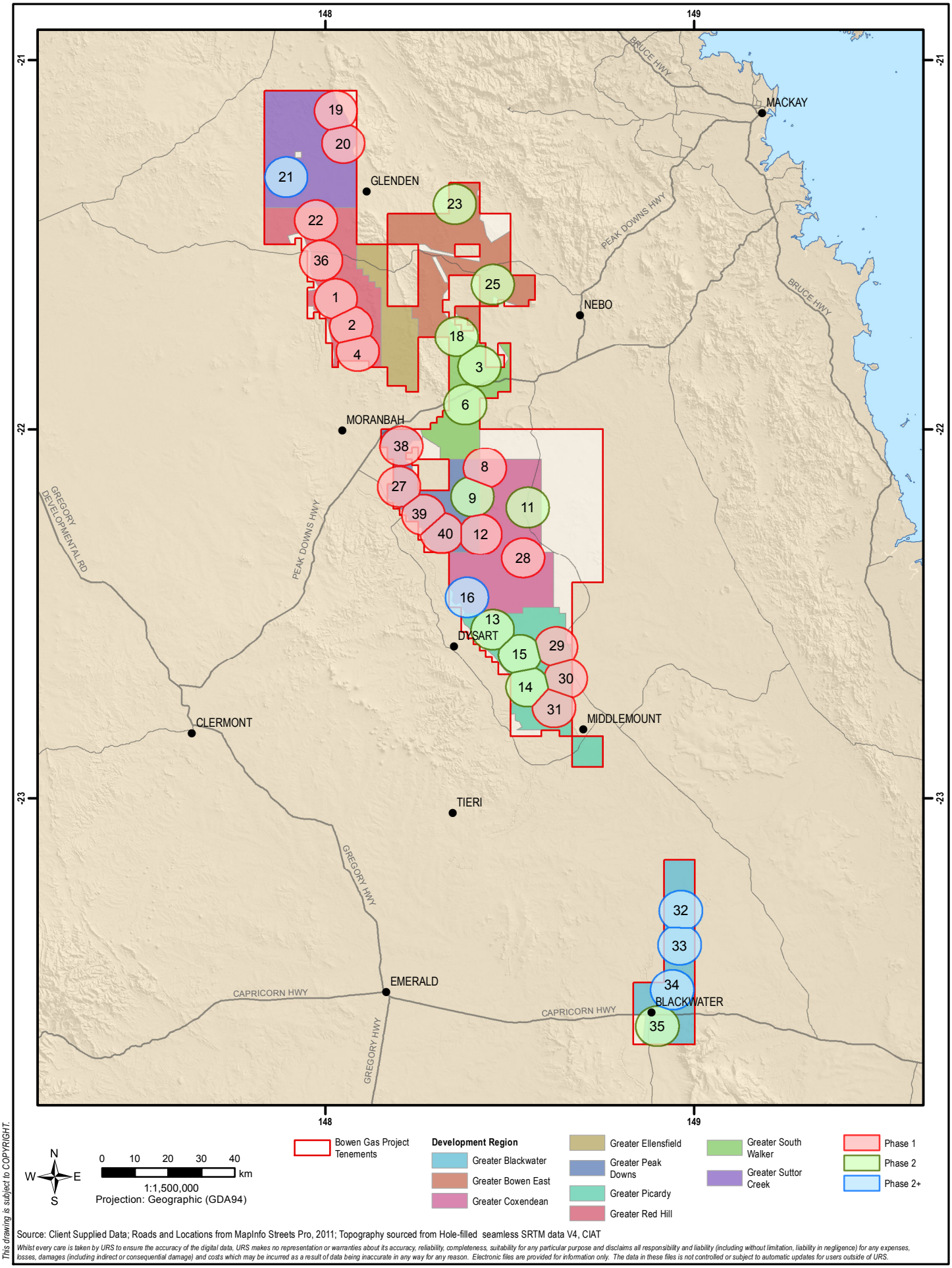
2. The area of disturbance as a percentage of the total environmental value area within each drainage area was then calculated.

3. Disturbance percentages from the sample conceptual footprint were applied to each individual environmental value within drainage areas corresponding to the same well densities as drainage areas in the sample conceptual footprint.

Based on the current Project conceptual development footprint and using the method described above, 6,836 ha of remnant vegetation will potentially be impacted. The maximum potential impacts to each RE within each individual drainage area is presented in the Terrestrial Ecology Technical Report (Appendix B of Appendix P) of the SREIS.

Further analysis of the potential impact data shows that of 6,836 ha of remnant vegetation potentially impacted, approximately 580.5 ha is endangered REs (biodiversity status) and 1,618 ha is of concern REs (biodiversity status) with the remainder identified as ‘no concern at present’.

A full detailed breakdown of the REs and other ecological values potentially impacted is presented in the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS.



Source: Client Supplied Data; Roads and Locations from MapInfo Streets Pro, 2011; Topography sourced from Hole-filled seamless SRTM data V4, CIAT

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BOWEN GAS PROJECT SREIS

INDICATIVE PROJECT LOCATION AND DEVELOPMENT AREAS

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TERRESTRIAL ECOLOGY

Figure: 11-2

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11.7 Potential Impacts on Ecological Values

Potential impacts on ecological values are presented in the Terrestrial Ecology chapter (Section 17) and Terrestrial Ecology Technical Report (Appendix P) of the EIS. As the disturbance footprint is still conceptual, it is not possible to ascertain the ultimate potential impacts to ecological values. However, potential areas of disturbance for REs, TECs and species of conservation significance have been estimated as part of the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS. The estimates have been developed using a two-step process involving the mapping of potential habitat in conjunction with a calculation of disturbance. The process used is detailed below in Section 11.7.1.

11.7.1 Mapping of Potential Habitat

As part of the MNES Report (Appendix J) of the SREIS, potential habitat mapping of MNES species and communities was undertaken. The aim of the potential habitat mapping was to identify MNES potential habitat across the entire project. The potential habitat maps will be used as a planning tool during the design and construction stage of the project to assist in the placement infrastructure. Where possible, during the design stage, areas of mapped potential habitat will be avoided and changes to designs will be made with regard to habitat mapping. The mapping will also be used to determine the potential impact of the project on MNES. Where applicable, this will determine the offset requirements for the Project.

Arrow has incorporated light detection and ranging (LIDAR) to refine and improve the potential habitat mapping across the project area. LIDAR data collected for the Project area was separated into layers of the classification values corresponding with ground, low vegetation, medium vegetation, and high vegetation, allowing a visual representation of each classification value. These classification layers were then able to be interrogated by GIS software to provide the following information:

- Canopy density of individual canopy height classes;
- Analysis of slope gradient;
- Identification and delineation of watercourse banks; and
- Identification of ground layer habitat features.

The information obtained from the LiDAR data was incorporated into the species potential habitat mapping, where appropriate. A full description of the process used is presented in the MNES Report (Appendix J) of the SREIS. This process was used in conjunction with the disturbance calculation method (Section 11.7.2), below to estimate potential offsets for EPBC and NC Act-listed vegetation communities and species.

11.7.2 Estimates of Disturbance

An analysis of the EHP RE data has been conducted for each drainage area. Due to the nature of CSG development, the Project footprint will be developed in line with the framework approach. A sample conceptual footprint has been used to calculate the potential disturbance for the life of the project. The disturbance limits calculated are the maximum disturbance footprint. The actual disturbance during the Project expected to be lower than those areas presented in the Terrestrial Ecology Technical Report (Appendix B of Appendix I) of the SREIS.

Based on the current Project conceptual development footprint, approximately 6,836 ha of remnant vegetation is calculated as the estimated maximum area to potentially be impacted. The estimated maximum area for potential impacts to each RE within each individual drainage area is presented in the Terrestrial Ecology Technical Report (Appendix B of Appendix I) of the SREIS.

Further analysis of the estimated maximum disturbance data shows that of the remnant vegetation potentially impacted, approximately 580.5 ha is endangered REs (biodiversity status) and 1,618 ha is of concern REs (biodiversity status) with the remainder identified as no concern at present.

Estimates of disturbance for additional NC Act and EPBC Act values are also detailed in the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS. Table 11-7, below, lists the tables in the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS in which respective potential disturbance calculations are presented.

Table 11-7 Disturbance Data Presented in the Environmental Offsets Strategic Management Plan (Appendix P) of the SREIS

Table in Appendix P	Values presented
Table 7-3	Endangered and Of concern REs
Table 7-4	Threatened Ecological Communities
Table 7-5	Threatened Fauna and Flora Species (EPBC Act and NC Act)
Table 7-6	State Significant Biodiversity Values (including HVR, Essential Habitat and Wetlands)

11.8 Refinement of Mitigation Measures

11.8.1 Existing EIS Commitments

Table 11-8 summarises the commitments presented in the EIS developed to minimise impacts to terrestrial ecology values. The EIS found that Project design and site selection for specific infrastructure that seeks to avoid these high-value sites is the primary means by which protection for terrestrial ecology values will be achieved.

These commitments are still valid with respect to the conceptual Project design as presented in the SREIS. Revised commitments are also presented in Table 11-9. This update has resulted from changes made to the project description since the EIS was finalised and the decision to further clarify the intent of a commitment (e.g., through the consolidation of similar commitments to avoid inconsistent wording). A full list of all project commitments, including those that remain unchanged from the EIS, and details of those that have changed, are included in the Commitments Update (Appendix O) of the SREIS. Additional and complementary management strategies developed as part of the SREIS are also presented in Section 11.8.2.

Table 11-8 EIS Commitments to Reduce the Significance of Impacts to Terrestrial Ecology Values in the Project Development Area

No.	Commitment
B130	Avoid all disturbance within Homevale National Park (Category A ESAs).
B131	Aim to avoid disturbance within the following areas: • Endangered EPBC Act TECs: Brigalow Ecological Community (REs 11.3.1, 11.9.1, 11.9.5, 11.4.8, 11.4.9 and 11.5.16); Natural Grasslands Ecological Community (RE 11.8.11); Semi-evergreen Vine Thicket Ecological Community (REs 11.5.15, 11.8.3 and 11.8.13); Weeping Myall Woodlands (REs 11.3.2 and 11.3.28); • Category B ESAs; • Category C ESAs including Arthur's Bluff State Forest and gazetted nature reserves; • Stock routes and state or regionally significant bioregional wildlife corridors; • Essential habitat; • Core habitat for EVNT species; • State forests and resource reserves; and • State-listed 'of concern' REs.
B132	Conduct pre-construction / pre-clearance surveys to identify any additional areas that need to be avoided. Include as a minimum: • Vegetation mapping at a scale suitable for site-specific planning; • Identification of core habitats for EVNT species; and • Identification of site-specific sensitive areas (e.g. ESAs) that require avoidance or buffers).
B133	Attempt to locate wells, gathering lines and access tracks within previous clearings or non-remnant vegetation if possible.
B134	Design infrastructure to avoid undisturbed tracts of remnant vegetation, where practical. Where collection and gathering infrastructure is to be placed within contiguous vegetation, collection networks should be designed to avoid dissection.
B135	Access track location should avoid the repeated isolation of small parcels of remnant vegetation from more continuous tracts.
B136	Minimise vegetation disturbance wherever practical. Corridors for linear infrastructure should be as narrow as practical, particularly when crossing linear corridors of vegetation (e.g. Isaac River and Suttor Creek). Areas cleared for field development should be as small as practical.
B137	Retain habitat trees where practicable.
B138	Avoid removing riparian vegetation when directional drilling and reduction of right of ways where practical.
B139	Construct infrastructure within previously disturbed vegetation in preference to areas with higher biodiversity values
B140	Deviate access tracks and pipelines around sensitive vegetation where practicable.
B141	Avoid construction activities in waterbodies frequented by migratory species.
B142	Apply sensitive infrastructure design principles to avoid watercourse, drainage lines and riparian areas where practicable.
B143	Design creek crossings to ensure that existing flow regimes are maintained.
B144	Preparation of biodiversity 11.7.2 (DSEWPaC, 2011; DERM, 2011) for Commonwealth and State significant biodiversity values.
B145	Disturbance exclusion zones (or management buffers) will be established and managed during

No.	Commitment
	construction and operations to effectively protect ESAs. This may include the following actions: • Manage impacts to Category A, B and C ESAs through implementation of management buffers. The buffers outlined below are indicative based on current regulatory conditions, however these may be subject to change in future. The buffers that will be implemented for the project will be in line with the regulatory requirements at the time of implementation. Indicative buffers at this time include: — In areas mapped as high constraint a buffer of 100 m, measured from the bank edge, will be adopted during all phases of the Project, with a further 100 m constrained to low impact activities; and — For areas mapped as moderate constraint, the following buffer zones, measured from the bank edge, will be adopted during all phases of the Project: • a riparian buffer of 50 m width on either side of first and second order streams; • a riparian buffer of 100 m width on either side of third, fourth, fifth and higher order streams; • Clearly identify buffers for sensitive areas that require avoidance; • Develop site induction procedures to ensure that all worksite personnel, including contractors are made aware of the location of these sensitive habitats (and buffers) and are guided by qualified personnel when clearing is undertaken; and • Demarcate ESA buffers and educate workers in regard to necessary site access protocols and requirements.
B146	Implement noise control techniques in accordance with the noise and vibration commitments and standard industry noise suppression techniques.
B147	All lighting should be directed into the infrastructure siting rather than dispersed into native vegetation when sites are adjacent to intact habitat.
B148	Where possible restrict traffic to designated access tracks.
B149	Prohibit harassment of wildlife and the unauthorised collection of flora or fauna, unless directed by a suitably qualified and experienced person.
B150	Fell trees away from existing vegetation not identified for removal where practicable.
B151	Avoid damaging trees (e.g. through scraping of tree trunk or breaking of limbs by equipment) not identified by removal where practicable.
B152	A detailed pest management plan will be developed to mitigate and manage the potential spread of pest flora and fauna species.
B153	Suitably qualified animal handler or ecologist to capture injured wildlife, where possible. Injured wildlife resultant from land clearing will be taken to a qualified veterinary surgeon where practical.
B154	Develop speed limits on Project controlled roads with due consideration to reduce the potential for vehicle collisions with wildlife.
B155	Undertake pre-clearing surveys to determine the likelihood of the species occurring.
B156	Undertake partial rehabilitation of gathering lines and other linear infrastructure to reduce edge effects (including weed invasion) and maintain movement rates.
B157	Undertake rehabilitation of available areas consistent with pre-clearing habitats, to increase the rate of recovery.
B158	Undertake weed monitoring and targeted weed control measures within sensitive EVNT habitats (particularly threatened communities such as brigalow and native grasslands).
B159	Trenches should be inspected and monitored as per the APIA *Code of Environmental Practice.*
B160	Install and maintain appropriate sediment and erosion control structures at work sites.

No.	Commitment
B161	Woody debris, logs and rocks should be retained for use in rehabilitation. Where practical, these should be piled along the edge of the cleared corridor. However, spreading these features over part or all of the corridor is preferred as it will provide refugia for crossing fauna. Systematic removal of surface debris should be avoided and cleared timber should never be burnt.
B162	Plant species used for rehabilitation are specific to the original ecosystem and local provenance, wherever possible unless the area has been cropped or contains improved pasture to be reinstated.
B163	Data collection, particularly of EVNT species identified during pre-clearing surveys, during trench checking or in other Project related activities, should be ongoing until rehabilitation is complete.
B164	Monitoring programs should focus on those sensitive ecological values at risk of a high to extremely high level of residual impact.
B165	Consider targeted monitoring effort conducted in co-operation with the proponents of overlapping Projects. Particularly suited species to such monitoring include ornamental snake (*Denisonia maculata*), koala (*Phascolarctos cinereus*) and brigalow scaly-foot (*Paradelma orientalis*).
B166	Inspect management buffers and areas of avoidance to ensure boundaries are clearly delineated prior to clearing.
B167	Monitor during and after clearing activities to ensure no unauthorised encroachment has occurred.
B168	Reduce the impact of CSG water on soil structure and aquatic values, by designing and constructing wells in accordance with the *Code of Practice for Constructing and Abandoning CSG wells in Queensland* (NRM, 2013).
B169	Where EVNT species are identified in proposed development areas, consider mitigation measures such as translocation and/or propagation of flora species. Monitor progress of any translocation programs in accordance with the relevant translocation management plans.
B170	Inspect food scrap bins and exclusion fences to ensure effectiveness.
B171	In accordance with the Pest Management Plan routinely inspect for pest flora and evidence of pest fauna within Project disturbed areas.
B172	Design washdown facilities to ensure that runoff is contained on site and does not transfer weed seeds, spores or infected soils to adjacent areas. Treat or dispose of washdown solids in a registered landfill.
B173	Minimise the time a trench is left open. Construct exit points when construction is within 1 km of native vegetation, using appropriate material. Provide fauna refuges, such as sawdust-filled bags, regularly through areas of high fauna activity.

Table 11-9 Revised Terrestrial Ecology Commitments

No.	Revised / New Commitment	Rationale
B144	Preparation of biodiversity offsets (DSEWPaC, 2011; DERM, 2011) for Commonwealth and State significant biodiversity values	Reference updated
B145	Disturbance exclusion zones (or management buffers) will be established and managed during construction and operations to effectively protect ESAs as defined by the project's constraints mapping (outlined in Section 7 and detailed in Constraints Mapping (Appendix BB of the EIS).	Amended to clarify intent
B153	Suitably qualified animal handler or ecologist to capture injured wildlife, where possible. Injured wildlife resultant from land clearing will be taken to a qualified veterinary surgeon or carer where practical.	Amended to clarify intent

No.	Revised / New Commitment	Rationale
B155	Undertake pre-clearing surveys to determine the likelihood of the species (including weeds) occurring.	Combined with commitment B231 to clarify intent
B166	Ensure avoidance boundaries are clearly delineated prior to clearing.	Amended to clarify intent
B168	Reduce the impact of CSG water on soil structure and aquatic values, by designing and constructing wells in accordance with the *Code of Practice for Constructing and Abandoning CSG wells in Queensland* (NRM 2013).	Amended to clarify intent
B172	Design washdown facilities to ensure that runoff is contained on site and does not transfer weed seeds, spores or infected soils to adjacent areas.	Amended to clarify intent
B176	Reinstate drainage lines to pre-disturbance condition.	Amended to clarify intent
B184	Prevent fauna being harmed from entrapment during construction and operation of dams.	Amended to clarify intent in line with legislative requirement

11.8.2 SREIS Additional Mitigation Approaches

11.8.2.1 Offset Strategy

An Environmental Offsets Strategic Management Plan (Appendix P) has been prepared for the SREIS to outline Arrow's strategy to meet environmental offset obligations for the Project. The aim of the Plan is to facilitate discussion with EHP and the Department of the Environment on suitable offsets for unavoidable losses of vegetation and habitat incurred in constructing the Project.

The Plan describes the measures taken to avoid and minimise impacts, the expected disturbance to terrestrial ecology environmental values, and evidence that there are opportunities to offset the estimated losses of remnant vegetation, species and habitat. It details Arrow's preferred approach to the provision of environmental offsets. As an outcome of the Plan, a range of Commonwealth and State values have been identified as potentially subject to offsetting requirements, including:

- Nationally listed threatened species and ecological communities;
- Remnant endangered REs;
- Remnant endangered grassland REs;
- Remnant of concern REs;
- Remnant of concern grassland REs;
- Threshold REs;
- Essential Habitat;
- Wetland (VM Act);
- Significant wetlands (VM Act);
- Watercourses;
- Protected animals;
- Protected Plants; and

- Wetland Protection Areas.

Arrow has previously developed a staged approach that accounts for actual losses. In line with the Framework approach, the staged approach manages unavoidable losses and incentivises avoidance to protect environmental values. The staged approach for the project will involve the provision of an up-front offset for the Phase 1 disturbance areas. As design and construction progresses through the other project Phases, an assessment will be carried out to determine the offset requirements as they become apparent. The steps for providing offsets using the staged approach include:

- Assess - determine the estimated area of disturbance using conceptual field development plans and detailed GIS analysis of mapped biodiversity values;
- Demonstrate - avoidance of biodiversity values through review of estimated disturbance areas against the actual disturbance which will be undertaken; and
- Acquit - source offsets to meet criteria for the specific environmental value and discharge offset.

As part of the staged approach, estimated impacts are reconciled against actual impacts and the balance accrued against the values actually offset.

11.8.2.2 Environmental Standards, Procedures and Guidelines

To ensure a consistent approach to ecological assessments, implementing management measures and data management Arrow has developed a range of Environmental Standards and Procedures as part of their overall Environment Policy. Standards procedures, guidelines and checklists relevant to terrestrial ecology are listed in Table 11-10.

11.8.2.3 Preclearance Surveys and Refinement of Vegetation Mapping

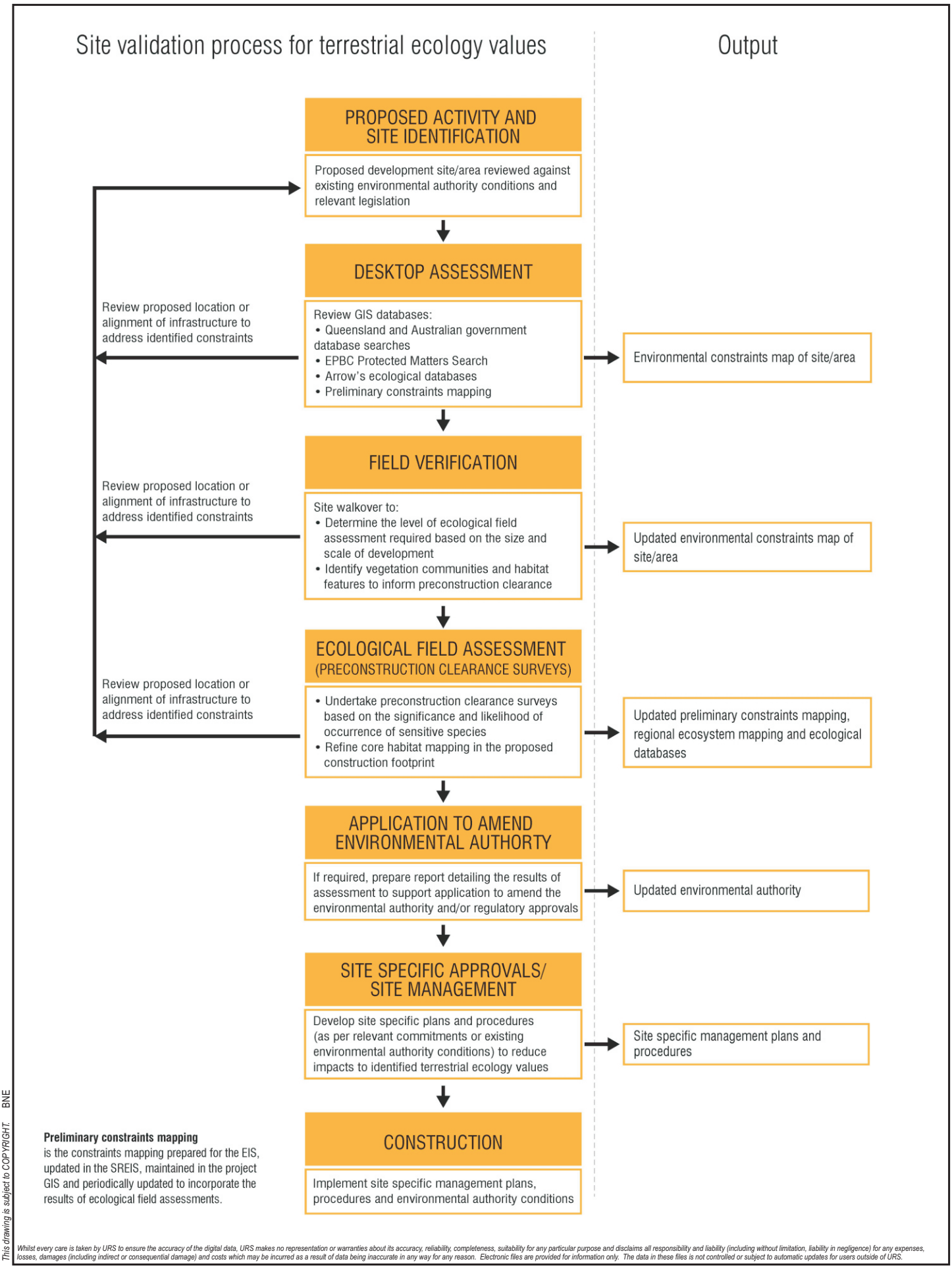
To assist in mitigating impacts, pre-clearance surveys, coupled with refined vegetation mapping at an appropriate scale, will be undertaken prior to development to quantify the presence of EVNT species and habitats. Following further field survey and revised mapping, possible habitat may be revised to "habitat known" or can be revised to areas in which the absence of EVNT habitat is known. This is consistent with commitments B132 and B155 as presented in the EIS (refer to Table 11-8).

The methodology for undertaking pre-clearance surveys will be implemented through Arrow's Ecological Impact Assessment Procedure (99-H-PR-0081), Fauna Survey Guideline (99-H-GDL-0061) and Ecological Survey Guideline (99-H-GDL-00091), as per Table 11-10 and as presented in the Terrestrial Ecology Technical Report (Appendix C of Appendix P) of the SREIS.

A flow chart outlining Arrow's process for ground truthing and site validation of ecological values is also provided below in Figure 11-3.

Table 11-10 Arrow's Environmental Standards, Procedures and Guidelines relating to Terrestrial Ecology

Standard	Procedures	Guidelines
Biodiversity Standard 99-H-MSS-0034	Fauna Management Procedure 99-H-PR-0075	Fauna Management Guideline 99-H-GDL-0060
		Artificial Habitats Monitoring Guideline (under development)
		Bat Box Monitoring Guideline 99-H-GDL-00098
	Ecological Impact Assessment Procedure 99-H-PR-0081	Fauna Survey Guideline 99-H-GDL-0061
		Ecological Survey Guideline 99-H-GDL-00091
		Environmental Offset Assessment Guideline 99-H-GDL-0062
		Ecological Desktop Assessment Guideline 99-H-GDL-0088 (under development)
Land Management (Soil) Standard	Land Disturbance Procedure 99-V-PR-0038	Site Preparation and Vegetation Clearing Guideline 99-H-GDL-00102
		Erosion and Sediment Control Guideline 99-H-GDL-00101
	Weed and Pathogen Management Procedure 99-H-PR-0030	Weed and Pathogen Management Guideline 99-H-GDL-0076
		Weed Species Pest Management Guidelines
		Weed Control Application Guideline 99-H-GDL-0067
	Vehicle and Machinery Hygiene Procedure 99-V-PR-0037	Visual Inspection Vehicle Checklist 99-V-CHK-0002
		Weed Hygiene Declaration Vehicle Checklist 99-H-CHK-0010
		Certified Clean Vehicle Checklist 99-V-CHK-0003
		Vehicle/Machinery Weed Hygiene Declaration Form 99-V-FM-0030
	Vertebrate Pest Management Procedure 99-H-PR-0119	Vertebrate Pest Guideline - Humane Destruction 99-H-GDL-0073
		Vertebrate Pest Guideline - Trapping 99-H-GDL-0074
		Vertebrate Pest Guideline - Baiting 99-H-GDL-0075
	Rehabilitation Procedure 99-H-PR-0088	Rehabilitation Guideline 99-H-GDL-0081
		Rehabilitation Monitoring Guideline 99-H-GDL-0077
		Final Rehabilitation Completions Form 99-H-FM-0082
		Rehabilitation Monitoring Assessment Form 99-H-FM-0098
		Rehabilitation Preparation (Legacy Sites) Checklist 99-H-CHK-00047



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SITE VALIDATION PROCESS FOR TERRESTRIAL ECOLOGY VALUES

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TERRESTRIAL ECOLOGY Figure: **11-3**

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